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"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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MOUNT ST. ELIAS.

La spedizione di sua Altezza Reale il Principe Luigi Amedeo di Savoia, Duca degli Abruzzi al Monte Sant' Elia (*Alaska*) 1897. Da Dottore Filippo de Filippi; illustrata da Vittorio Sella. Pp. xvii + 273; with 34 plates, 4 panoramic views, 2 maps and 115 figures in text. A beneficio delle Guide Alpine Italiane. (Milano: U. Hoepli, 1900.)

MOUNT ST. ELIAS, with an altitude, as now ascertained, of 18,092 feet, stands—a majestic corner-post—exactly at the angle where the Alaskan boundary-line ceases to run parallel to the coast and strikes northward along the 141st meridian, and its summit is now generally acknowledged to lie on the Canadian side of the frontier. Whether it maintain its supposed pre-eminence among the mountains of the North American continent, or whether it eventually prove to be overtopped by Mount Logan, its great neighbour on the north, or, as the most recent explorations seem to indicate, by Mount McKinley, one of the yet unvisited peaks to the westward, it must, from its commanding position on the verge of the open ocean, always impress the imagination as the grandest of the Alaskan Chain. In recalling the fact that the mountain was for long erroneously supposed to be a volcano, Mr. Douglas Freshfield has told us, on the authority of the poet himself, that Tennyson had Mount St. Elias in mind when he described the landscape of a volcano among snow as one of the pictures on the walls of "The Palace of Art" (see *The Alpine Journal*, vol. xix. p. 174).

So far as our present knowledge goes, nowhere else on the face of the globe is there so great a vertical range of snow and ice as among these Alaskan mountains. On Mount St. Elias the permanent snow-line comes down to within about 3000 feet of the sea, while the enormous glaciers nourished by the excessive humidity of the climate not only descend to sea-level, but unite and spread out in a vast plain of ice covering an estimated area of 1500 square miles between the foot of the mountain and the ocean.

Thus entrenched in ice sheets, so that even its base is defended, it is not surprising that the mountain withstood several attacks before it was conquered. The first attempt was made, in 1886, by Messrs. Libbey, Schwatka and Seton-Karr; the next, in 1888, by Messrs. Topham, Broke and Williams; the third and fourth, by Prof. I. C. Russell, in 1890 and 1891; and the fifth, by Prof. H. G. Bryant, in 1897, almost simultaneously with the successful Italian expedition. Of these explorers, Prof. Russell achieved in every way the most important results, bad weather alone preventing his complete success in 1891, after an altitude of 14,500 feet had been attained and the practicability of the ascent had been demonstrated. Prof. Russell correctly determined the height of the mountain, and carried out investigations upon its physical characteristics which proved of high scientific importance. Lieut. Seton-Karr had previously called attention to the singular condition of the glaciers at the foot of the mountain, where immense piles of morainic debris, in places overgrown with dense vegetation, hide the marginal surface of the ice; but it was not until Prof. Russell published his more adequate descriptions that geologists fully recognised the value of the phenomena of the "piedmont" ice in elucidating the conditions of ice-covered lowlands in general during the Glacial Period, and especially during its closing stages. So closely has Prof. Russell's name become associated with the mountain, that one cannot stifle a regret that the satisfaction of being first upon the summit did not fall to his lot. In the volume before us, however, we are glad to find a graceful acknowledgment of the work of previous explorers, in a chapter having for its motto this quotation, from Mr. D. Freshfield:—

"Those who went first and opened the way are not less entitled to credit than those who came afterwards and reaped the fruit of their predecessors' labours."

The leader of the Italian expedition, H.R.H. Prince Louis of Savoy, in planning an ascent higher than the Alps could offer, had at first contemplated an attack upon one of the great peaks of the Himalayas. Forced by unfavourable circumstances to abandon this idea, he turned for consolation to Mount St. Elias. He could not have selected a more princely amusement, or a better exercise in skilful organisation and patient endurance. That he achieved his object without mishap, and that he and his little band of fellow-countrymen had the patriotic satisfaction of planting the Italian flag on a summit assuredly never before trodden by the foot of man, was due to the careful forethought with which all the preliminary arrangements of the expedition were planned.

A graphic account of the ascent was communicated by one of the party, Dr. Filippo de Filippi, to the English Alpine Club a few months afterwards, and was published in the *Alpine Journal* for May 1898. As chronicler of the expedition, Dr. Filippi has now expanded his story in the handsome and portly volume before us, in which he deals at full length with the conditions of the climb, and describes in glowing language the wild grandeur of the scenery. The beautiful photogravure plates and the illustrations in the letterpress, with which the book is so bountifully provided, are reproduced from photographs taken, for the most part, by Vittorio Sella, who was also of the party, and these are especially valuable as a faithful and permanent record of the physical characters of this seldom-visited region, and particularly of the untraversed wilderness of snow and mountain peaks to the northward of St. Elias. Among many that are excellent, there is one plate (p. 136), showing the snowy eastern spurs of St. Elias delicately fluted by innumerable avalanches, which seems to us peculiarly impressive.

Of the ten chapters of the book, only five deal with the actual ascent; the first three, and also the final chapter, are devoted to the outward and homeward journeys; the fourth to the previous history of the mountain; and appendices, covering seventy-four pages, to the equipment and scientific results of the expedition.

As Russell had foretold, the mountaineering difficulties encountered during the climb were slight, and the adventure resolved itself into a long, arduous struggle upward for thirty days, usually in wretched weather, over interminable snow-fields and glaciers. The character of the climb was pithily given by one of the guides, in answer to inquiries after his return:—"C'est comme le Breithorn, seulement beaucoup plus haut." The expedition, consisting of the Prince with four compatriots, five Italian guides, and ten Americans who acted as porters, landed safely near Point Manby, at the foot of the moraine of the Malaspina ice-field, on the evening of June 23, and on July 1 started forward across the ice, all subsequent encampments being upon snow. Traversing the Malaspina in three days, partly in dense fog, the party struck upward along the eastern flank of its great tributary the Seward Glacier, which was afterwards crossed, and the Agassiz Glacier gained, at an altitude of only 3480 feet, by Russell's previous route through the Dome Pass, on July 13. Thence the explorers forced their way slowly up the Newton Glacier, through labyrinths of crevasses and ice-falls, for thirteen days, of which only three were fine. Fortunately the fog and snow which fell to their lot were unaccompanied by either wind or electrical disturbance; nor did the party suffer from cold, the temperature ranging steadily between 25° and 35° F. Their progress along this glacier averaged only about 1 mile 500 yards daily. At this stage they received news that the expedition led by Prof. Bryant, which had set out a few days ahead of them, had been compelled to return to the coast owing to the illness of one of its members, after having reached the foot of the Newton Glacier.

The Italians were greatly impressed with the vivid colouring of the névé and ice even in the thickest weather, the tints ranging from brilliant turquoise and azure to the deepest blue, without the greenish tinge familiar to them in the Alps. This and the weird atmospheric effects in these mountain solitudes are eloquently described by Dr. Filippi.

Having left the American porters behind, and established their advance camp on the col at the head of the Newton valley, at an altitude of 12,287 feet, the success of the mountaineers depended solely upon the weather. Fortunately this proved more favourable than at the lower elevations, and they were able, without delay, to attack the summit. It was absolutely calm and clear on July 31, when after a heavy climb of 5800 feet from their last bivouac, during which the majority of the party were more or less affected by mountain-sickness, the Prince and his comrades reached the crest just before noon. The thermometer registered a temperature of 10·5° F., and the barometer stood at 15 inches 15 lines. The height of the mountain as determined by the barometer was 18,092 feet, which is in remarkably close agreement with Russell's figures, 18,100 feet, obtained by triangulation.

From the summit they saw the majestic mass of Mount Logan to the north-eastward, sinking north-westward into a very intricate lower chain, while to the westward was a chaos of low ridges, neves and glaciers, overtopped at a distance of some hundred miles or so by three great snowy giants as yet unexplored, which proffer substantial work for the future.

Then came the descent and the return to the coast, which was safely reached in ten days. Some of the lower ridges overlooking the Malaspina Glacier, where they had previously found snow, were now knee-deep in blossoming plants.

The appendices to the volume are, from a scientific standpoint, not particularly important. The first describes the equipment of the expedition in detail, and should be of service to explorers of similar regions. The excellent plan was adopted of packing the supplies in tin boxes, each containing sufficient material of every kind for twenty-four hours. The second appendix consists of meteorological tables, giving the simultaneous observations made daily between June 25 and August 3 by the expedition, and by the Rev. C. J. Hendricksen, of the Swedish Mission at Yakutat, at the foot of the mountain. The third deals with the health of the party. The absence of colds, rheumatism, or other ill results from the trying conditions of the journey is made the subject of comment; and the symptoms which effected most of the explorers during the final stages of the ascent are fully discussed, but it is thought that these might be in part attributed to excitement and want of sleep. The only case of real illness was that of one of the American porters, who, after having passed a night, during the return, on ground covered by vegetation, on the Hitchcock Hills, was seized with an attack of malaria while crossing the Malaspina Glacier. The terrible plague of mosquitoes on the coastal strip of forest is especially mentioned. Another appendix, on the zoological material, is principally devoted to the description of a new arachnid and of a new oligochæte annelid collected on the snow. An appendix on the rocks and minerals is for the most part a discussion of Russell's previous work, but contains the information that the outcrops near the summit of the mountain consist of typical diorite passing locally into hornblendite.

The ascent of Mount St. Elias was an achievement worthy of a prince, and this handsome volume is worthy of the achievement. Beautifully printed, magnificently illustrated and tastefully bound, it reflects credit upon all concerned in its production. But (alas! the inevitable but!) it has no index.

G. W. L.

A HYDRODYNAMICAL THEORY OF ACTION AT A DISTANCE.

Vorlesungen über hydrodynamische Fernkräfte nach C. A. Bjerknes' Theorie. Von V. Bjerknes. Band i. Pp. 338; with 40 figures. (Leipzig: Johann Ambrosius Barth, 1900.)

THEORIES of matter—or should we not rather call them theories of *force*, since, in "explaining" the properties of matter, we are mainly concerned with those manifestations which we say are due to "force"—naturally fall into two distinct classes. The first class includes those hypotheses which regard continuous matter as being built up of discrete particles, and the direct action of finite portions of matter as being due to action at a distance of these particles. The second class includes those hypotheses which regard these particles as singularities in a continuous medium, and which attribute their action at a distance to the direct agency of the medium. In a certain sense, these two theories are reciprocal. In both, certain attributes are localised at points, and it is necessary to bridge over the distance between these points. According to the first hypothesis, a field of force pervades the intervening gaps; according to the second, they are filled with a distribution of mass. The belief that both hypotheses are possible, enables us to imagine that there may be no limit to the smallness of the scale on which Nature conducts her operations, the phenomena occurring in any region being made to depend in their turn on others occurring in the far more minute regions which are regarded as constituting its ultimate elements, and these elements being in turn capable of further subdivision, and so on indefinitely.

In 1852, Lejeune-Dirichlet, being unacquainted with the works of Green and Stokes on this subject, published a paper containing the solution of the problem of the motion of a sphere in an incompressible fluid. In a course of lectures given at Göttingen in 1855–56, Dirichlet gave the corresponding solution for a sphere fixed in a steady current, and invited his pupils to attempt the solution for an ellipsoid. Among these pupils were Schering, who solved the problem, and C. A. Bjerknes, who gave a generalisation for space of n dimensions. At this time the doctrine of action at a distance may have been said to be at its zenith, and Göttingen had given birth only a few years previously to the last brilliant product of that doctrine, Weber's Law. As a foreigner, Bjerknes was, however, less influenced by the views then prevailing in the Göttingen school, and a volume of Euler's correspondence falling into his hands caused him to oppose the doctrine of action at a distance. A fresh light was thrown on the hypothesis of a continuous all-pervading medium by Dirichlet's discovery that a sphere moving in an incompressible perfect fluid experiences no retardation from the fluid, and an impetus was given to Bjerknes to develop Dirichlet's investigations in a direction widely differing from anything then contemplated by his professor.

From the effects of purely translational motions of two spheres, Bjerknes was led on to consider the mutual actions of two pulsating spheres, and discovered that such spheres attract or repel one another according as their phases are the same or opposite, the law of force being that of the inverse square. Bjerknes found, moreover, that the expressions for the forces acting on a sphere moving in liquid consisted of two terms, which he distinguished as "inductional forces" and "energy forces," a result which he arrived at by considering the expressions for the pressures on the spheres, but which might have been found more readily had Thomson and Tait's application of Hamilton's principle been then known to him. About 1875, Bjerknes published a paper in which he established the hydrodynamical law of action and reaction, and the analogy with electric and magnetic action at a distance; and in the following year he gave an independent investigation based on the Hamiltonian principle.

From 1875 onwards, Bjerknes appears to have occupied himself chiefly with the terms of lowest order in the expressions for the forces; and in 1878 he discovered the law of rotation for oscillating spheres. Since then he seems to have devoted his attention mainly to electric and magnetic analogies, and in the middle of his eightieth year he completed the discussion of the "inductional forces," and by this means pushed the analogy between hydrodynamic action at a distance and electromagnetic phenomena as far as it could be pushed without departing from the fundamental hypotheses.

A complete account of these investigations was never published, and it remained for his son, Prof. V. Bjerknes, to embody them in the present volume. For three years Prof. V. Bjerknes has delivered courses of lectures on the subject at the University of Stockholm, and the book is practically based on these lectures. It is divided into four parts: the first, an introductory part, dealing with the general principles of vector fields and hydrodynamical equations; the second, dealing with the motion of the liquid surrounding a system of moving spheres treated from a kinematical standpoint; the third, dealing with the influence of the pressures on the motion of the spheres themselves; and the fourth, with the theory c apparent actions at a distance, of hydrodynamical o
In the second part, the diagrams of the stream lines due to a moving, oscillating or pulsating sphere in various fields of force are noticeable for their elegance.

It is to be wished that the courses of lectures which Prof. V. Bjerknes delivered on the work of his father could be taken as models of what university lectures should be, for the development of a theory such as the present affords an excellent and not difficult insight into